PLAN OF DEVELOPMENT NOW IN PROGRESS OF THE Northern Division OF THE MARIPOSA ESTATE.

SEPTEMBER, 1873.

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REVIEW

OF THE

NATURE, RESOURCES AND PLAN OF DEVELOPMENT

(NOW IN PROGRESS)

OF THE

NORTHERN DIVISION

OF THE

MARIPOSA ESTATE.

By B. SILLIMAN.

SEPTEMBER, 1873.

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To the Stockholders of the

MARIPOSA LAND AND MINING COMPANY.

GENTLEMEN: I have the honor to submit to you herewith a "Review of the Nature, Resources and Plan of Development (now in progress) of the Northern Division of the Mariposa Estate," by Prof. B. Silliman, of New Haven, a gentleman of experience in such matters, whose attention was early fixed upon your Estate, under its former management, and whose report, made to them in 1864, was reproduced in the volume published by this Company, in February of this year.

I have sought the advice and assistance of Prof. Silliman, that I might avail myself, for your benefit, and the best interests of the Estate, of the advantage of his intimate knowledge of the resources and capabilities of your property. I have for the past three months had many interviews and prolonged discussions with him on the whole subject; and have opened for his inspection and study all the sources of information at my command; not merely the correspondence, maps, plans and records of the office, but I have freely disclosed to him the results of my own personal knowledge of the

subject, ripened by many years of intimate familiarity with its whole history.

I have found him well prepared to master the whole problem, and to discuss the various plans I have long contemplated, and give them definite form and expression in the document which I now submit for your information. He entered with his well known zeal and industry upon the work, and it is but just to him to say, that I have derived from him important suggestions and advice, for the more perfect development of my own ideas. These views and suggestions you will find embodied in the "Review," so far as it is deemed needful at present to give expression to those portions of the entire plan, the full development of which, in all its details, is a work of such magnitude, that I have requested Prof. Silliman at this time to confine himself to the consideration only *of the northern portion of the Estate*, including the developments of the Mother Lode, by the River Tunnel, and the Deep Shaft on the Princeton Mine.

So far back as 1868 this plan of development, now in progress, was conceived by me, in its main features, and in 1872, when I was last on the property, I took steps to inaugurate it. I need not go with any detail at this time into the reasons which have until recently delayed its ful-

filment. Suffice it to say, the progress of the art of mining, and the changes in the relation of labor, have, only within a late period, rendered it possible to carry out with economy and success, and with the concurrence and approval of my associates in the Board of Direction, the great works which have now been commenced, as I conceive, under such auspicious conditions as to render success certain, and at a comparatively moderate cost.

The result of the River Tunnel will be, that we shall be able to mine and mill the ores laid open by it, in our Ophir Mills, at a total cost not exceeding three dollars ($3) per ton. I mean by this that three dollars will cover all costs of every description, including all construction and exploration, to be charged *pro rata* to the cost of the ores extracted and worked. All beyond this will be net profit.

My past convictions, and, if you please, enthusiasm in the great intrinsic merits of this property are well known to you. I now reaffirm my undiminished confidence in its present and future value; for my convictions have been deepened and strengthened by my constant study of the whole subject, and by the dawn of that system of development, which has so long been, with me, a cherished idea, and the inauguration of which I have now the pleasure of presenting to you, in a part

only of the entire plan, which can be carried out without embarrassment, the Estate being entirely free from debt or encumbrance of any kind.

Respectfully yours,

MARK BRUMAGIM.

New York, *September* 30, 1873.

P. S.—Since the foregoing was put in type, the manager of the Mariposa Estate reports to the Company in New York that a new vein, about five feet wide, has been struck on the line of the new River Tunnel, the first lot of ore taken from which—sixteen tons—has been worked at the Mills, and produced an average of over twenty-five dollars of gold per ton. Until further exploration we cannot know how extensive it is, but the indications are, that it is the most valuable gold ore body discovered in California, and that the net profits from it may more than equal the par value of the capital stock of the Company. This is but one of the many ore chimnies that will be undercut by the River Tunnel.

The late tests, made since September 1st, in the River Tunnel on the Estate, between hand drilling and the Burleigh Mechanical Drill, show—as to work in a given time—3 feet by hand drill, to 17 feet by the Burleigh Mechanical Drill; and as to cost—by hand drill—$43.87 per foot, to $18.75 per foot

by the Burleigh Mechanical Drill; in the latter amount are included all the extra expenses of removing the *debris*, laying the tramway, and cutting the water drain in the bottom of the Tunnel.

M. B., *President.*

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I.—LETTER TO MARK BRUMAGIM.

To Mark Brumagim,

President of the Mariposa Land and Mining Company, New York.

Sir—You have called upon me as a professional adviser to consult with you as to the best method of proceeding with the future development of the extensive properties now held by you under the well known Mariposa Grant. In the following pages I have briefly reviewed the nature and extent of your property ; to a very limited extent its former history and management ; the condition of the mining industry of the Pacific Coast as now developed ; what time and invention have done in the past ten years to simplify and cheapen mining processes ; going with some detail into the operations of the mechanical drilling machines, the air compressor—the diamond drill—the single hand drill—Chinese labor—and the new and more powerful explosives ; concluding with an account of the plan of development adopted, which will be found to be completely a new departure, growing out alike of the lessons of the past, and the possibilities of the present advanced state of the art of mining ; and also with some notice of the nature and extent of the

gold lodes on your estate, of the rate at which these may be developed, and of the reductions of the ores by water power, and with the most approved appliances.

You assure me your Company is now without interest-bearing or floating debt of any kind, and that all work upon the Estate is conducted upon a strictly cash basis.

The plans which I submit are such as to involve a considerable time for the realization of income. This delay is, in the nature of things, unavoidable, but is justified by the fact that the results are of permanent value, and must progressively raise the income of the Estate to a point before unknown, and impossible without the economies which will now be realized.

In May, 1864, I made a careful examination of the principal points of interest and active working on the Mariposa Estate at the request of the Trustees and Manager, the results of which were published by the old Company at the time. A reprint of this Report, with some unimportant omissions, will be found in the book lately issued by your Company (1873).

I have lately reviewed this Report in the light of many intervening years of experience, and with all the data which are now available.

Justice to myself, and to the vast property it

describes, requires me to say that the statements of fact and inference therefrom then made have since been substantially confirmed, both by the progress of development and by the neglect of it, and also by the opinions of other professional and non-professional men.

I am, yours respectfully,

B. SILLIMAN.

II.—OF THE NATURE AND EXTENT OF THE MARIPOSA ESTATE.

The Mariposa Estate is unlike any other mineral property in the United States, in the vast extent of its franchises, embracing about (70) seventy square miles of territory, or over (44,000) forty-four thousand acres of land held by the United States Patent, and within which are veins of gold-bearing quartz, the exact number and extent of which is unknown; but among which the so-called "Mother Lode" is a conspicuous member, extending through the Estate in a northwest and southeast direction for many miles, and exhibiting in conspicuous cliffs the auriferous quartz standing at an elevation of at least 1,500 feet above drainage. Through the northern end of the Estate flows the Merced River, a powerful stream, fed by the melting snows of the Sierras, and fresh from the waterfalls of the Yosemite Valley.

This stream has cut its way deep down in a precipitous trough through the Mother Lode, at which point it makes a sudden turn to the right, flowing northwesterly on its course to join the waters of the San Joaquin River and the sea. At this point a substantial dam has been built across the Merced River, furnishing a water power adequate to crush hundreds of tons of ores daily for the larger part of the year and during the season of floods, a volume of water greatly in excess of any probable demand.

It is at this point, under the system lately adopted (of which more anon), that hereafter all the milling operations on the estate will be conducted, which heretofore have been carried on at a serious expense by steam power at the various mines and mills remote from the river. The ores of the old Pine Tree and Josephine mines, nearest to the river were, under former administrations, mined and hauled to the Merced water mills under such disadvantages as greatly to enhance the cost and reduce the profit of treatment. Under the new system, as will appear further on, these ores can be delivered at the mills by water power and gravity at a minimum of cost.

It is difficult for one who has not visited and studied carefully this remarkable property to understand fully how greatly it differs from all other mining properties, in the variety and extent of its

ownerships and resources, and the multiplied chances it offers for new and profitable developments.

Its owners are the heirs of a system, once existing under the Spanish laws, which has now passed away. Under the existing mining laws of the United States, it is impossible for one set of owners to obtain a patent to more than two thousand feet in extent of mining ground. Hence we find, elsewhere in California and Nevada, to-day, conflicting claims to contiguous properties; and the narrow limits set by existing local laws often cut off the unfortunate owners of a profitable mine from following the rich shoot or chimney of ore which carries the wealth of their property into the limits of their adjoining neighbors.

All who are familiar with the history of mines in California and Nevada can without difficulty recall examples of this sudden transfer of value from one party to another, due to the limiting bounds of narrow claims on a few hundreds of feet of mining ground. For example, the famous Comstock lode of Nevada, which has turned out at least one hundred and fifty millions of silver and gold since 1859, upon a line of vein about three miles in length was, by the operation of the local mining laws, subdivided to such a degree that on the portion known as Gold Hill, ownerships existed of so small an extent as (10) ten feet linear, on the course of the

vein, which was there of great width on the pay shoot; and some of these in 1863-64 were sold at the rate of $15,000 to $20,000 per linear foot; even this enormous price is much exceeded by the present values at which the shares of the Crown Point and Belcher mines have been sold within the past two years. On this famous lode the valuable ores are found in "chimnies" or "shoots" where the great values are concentrated within the narrow compass of a few hundred feet linear at most, with a long stretch of unproductive vein matter between them. Such were the Ophir chimney at the north, the Gould, and Curry, and Savage chimney, the Hale and Norcross, and Chollar-Potosi chimney, and the Gold Hill chimney—each subdivided into numerous separate ownerships, and worked independently.*

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* The risks and annoyances attending contiguous and conflicting ownerships of mining ground are nowhere better illustrated than in the history of the Comstock lode, all growing out of a condition of things which is completely avoided by the large possessions of the Mariposa Estate.

The writer was, in 1864, quite familiar with the condition and resources of the Comstock lode as then developed. At that time the great mines on the Comstock were the Ophir and Mexican on the North, already in a decline, the Gould and Curry, Savage and Chollar-Potosi in the middle ground, and the Gold Hill series. In the great suit of the Savage *vs.* the North Potosi, tried in June, 1864, the ground taken by the

Now, on the Mariposa Estate there is a single gold-bearing vein, the "Mother Lode," which has there an extent of at least ten miles, broken up into numerous chimnies, and containing, above the drainage of the New River Tunnel, an amount of ores which cannot be safely computed, but which greatly exceed anything else of the kind in the whole range of mining in the precious metals, all held within one undivided ownership, and the whole of which may, by the present system, be brought to mill by gravity without the use of pumps or hoisting gear. It must be clearly understood that the average grade of these ores falls below the average grade of the silver ores of the Comstock; and the pay ground of the Mother Lode probably will never reach any such vast accumulations within narrow limits as are

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plaintiffs for the ejectment of the defendants was the "unity of the ledge." Up to that time the opinions of the most competent mining men, lawyers and experts had been divided on the question of their being one or many lodes on the Comstock.

After a careful study of the problem, by following out minutely all explorations, the writer went into court, and for the first time in the history of Washoe litigation, took in this controversy the unpopular ground that there was but one lode, of which the various croppings that had been separately claimed were only branches as of a main stem. This position he sustained against a storm of ridicule and contumely, ably

found in the Comstock; but it is vast enough to meet any reasonable demand, and we have yet to learn what it may be *in depth*, seeing that thus far the ores of the Mother Lode have elsewhere been found to improve, in both quality and volume, the deeper they have been worked.

But lest it may be thought unfair to institute a comparison between the greatest silver-bearing vein

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seconded in it, however, by the late Mr. Charles Bonner, then engineer in charge of the Gould and Curry mine. His view prevailed with the Commissioner before whom the cause was tried, and thus ended a long series of vexatious and costly suits which had previously greatly unsettled confidence and impeded exploration.

The professional man has often to submit for the time, as quietly as he can, to ridicule and unfriendly criticisms of his opinions, when these are either in advance of, or adverse to, those of interested parties. Such was the writer's experience, not only in the case above cited, but in other instances on the Comstock; as, for example, his estimate of the great values of the reserves in the "Red Body" of quartz on the Comstock, at that time generally considered almost worthless. The Chollar-Potosi Company, on whose grounds he then gave figures which were generally discredited as improbable, or even ridiculed as extravagant, have since extracted many times the value named by him from these reserves on which his calculations were predicated. The Gould and Curry Company, after the exhaustion of their rich bonanza, fell back upon the despised "Red Body," and for years maintained themselves upon it, nor is it yet quite exhausted. Thus time has its revenges for the professional man.

of the world and the greatest gold-bearing vein, let us compare the Mother Lode with itself, and with other gold-bearing regions in California. The "Mother Lode," so called, has been traced north of the Mariposa Estate for at least (70) seventy miles into Amador County, and some believe that it is seen again in the "Sierra Buttes," in Sierra County, but this is a point foreign to our present discussion. In this

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In like manner the writer predicted at that time the unity of the Gould and Curry and the Savage bonanza as one ore body, having for its main axis a southeasterly pitch; and that the probable law for the recurrence of new ore bodies would be that these would be found in ovoidal masses, not beneath the upper ones, but in a line trending to the southeast. This prediction was soon verified by the discovery of the new ore body of the Savage and Hale and Norcross (and the disappearance of the ore from the Gould and Curry) and has since found its most signal support in the wonderful discoveries of the body on which the Crown Point and Belcher mines are now working. These opinions were violently opposed by the advocates of the theory which assumed that the Comstock was a huge V shaped gash, in which the ore would be cut off by the junction of the foot and hanging wall at no great depth.

History has long since decided on which side the truth lay.

So, in the Mariposa, in 1864, the writer predicted the existence and operation of the same law, substantially, for the recurrence of bonanzas, or rich chimnies of ore, in the veins of gold-bearing quartz, and that barren zones would be found alternating with productive ground both horizontally and vertically with the same southeasterly trend.

C.S.L.

long stretch there are numerous breaks, wherever it is cut by streams and valleys; and the lode appears at one place, south of Jackson, to plunge under and disappear for over twenty miles. But it reappears again in great strength in Amador County, where it is seen enclosed in slates of a kind so similar to those which enclose it at the "Princeton Mine," on the Mariposa Estate, that the two sets of ores cannot be distinguished from each other in hand specimens.

Here the "Mother" furnishes, in the opinion of many Californians, the most productive cluster of mines now worked in that State, chief among which are the "Amador," "Keystone," "Oneida" and "Kennedy" Companies, and others of less note. Now the Princeton Mine above named is second to none of these in its former production of gold, over $3,000,000 having been taken from it, all above a horizon of 500 feet in depth, which is hardly more than one third the present depth of some of the Amador mines; while, as can be shown in detail at the proper time, the Princeton set embraces a wider range of promising mines than any group now known in Amador, and all these belonging to one ownership, and forming but a small portion of the aggregated wealth of the Mariposa Estate.

Again, it is generally agreed that in Nevada

County, in California, are to be found in the area embracing the towns of Grass Valley and Nevada City, mines of gold second to none in the world for steady and continued production through a long period of years. Here are "Massachusetts Hill," "Rocky Bar," "Gold Hill," and "Allison's Ranch," famed in early days, and yet good mines, while the "North Star," the "Empire," the "Eureka" and the "Idaho" stand out prominent now among the great mines of the world. The Eureka has divided over two millions of dollars to its fortunate owners, and still holds up a steady monthly dividend, notwithstanding the fact that its rich chimney of ore has plunged away S. E. into the Idaho—a striking illustration of what has been said already of the risks attending limited ownerships upon gold and silver bearing veins. We might extend this list to embrace many good mines in the vicinity of Nevada City, and allude to the important areas of auriferous gravel worked by hydraulic process. But it suffices to say, that all these valuable mines, separately held within the areas alluded to, are contained within a less extent of mining grounds than is held by the Mariposa Estate in one ownership.

Mr. Delano, a well-known banker at Grass Valley, in a lecture delivered in February, 1873, by him in that place, makes the following remarks respect-

ing the probable total product of gold in Nevada County, California, since 1849. No man has been better situated to learn of his own knowledge the facts of the case than Mr. Delano. He says: "Does any reflecting citizen doubt that the treasure is in our hills? We feel as assured of it as that the sun will rise to-morrow. Who can estimate the wealth of our mountains? We can only judge by what has been and what is now being produced. The wealth of Nevada County alone would be sufficient to pay the interest on our national debt. I have not the data by which I can determine the exact amount of gold taken out of the mines in the county since their discovery, but we can approximate it. Grass Valley mines have yielded, in round numbers, $40,000,000; Nevada City mines have probably shipped as much as $40,000,000; San Juan, we will say, at least $10,000,000; Columbia Hill, North Bloomfield, Washington, Omega, Cherokee and Woolsey's Flat, $10,000,000; other localities, $5,000,000. This foots up to the enormous sum of $105,000,000 in this one county; and, if the facts could be actually obtained, I feel confident that the amount would exceed this rather than fall below it—and the work is still going on. What we need at present is more capital to open and work our mines. We need concert of action in bringing facts to capitalists, and to show them that here is really a *bona fide*, good

and profitable field of investment for capital. We know that there is ; they do not know it. From the beginning to the present day, the mines of Grass Valley and Nevada County have been worked upon their merits. They have not been the subject of stock gambling operations, with its feverish, unhealthy excitement. They have sustained themselves by their own worth. They will continue to do so, and, though their developments may be slow, they will be sure."

Mr. Olmsted says, in one of his reports, that from the explorations made under his orders over portions only of the Mariposa Estate, he is confident that it is quite within the truth to say, that the out-crops of at least one thousand gold-bearing veins have been seen and recognized as such upon your property.

From this rapid survey of the subject, which could easily be much extended if it were desirable, it will be the more easy for those who have not visited the Estate, and become personally familiar with it, to understand how immensely greater it is in metallic value than the property of any ordinary mining company, whose ownership and operations are restricted within the narrow limits of a few hundreds or even thousands of feet on a single lode, and whose chances of success are consequently very restricted, and whose life in the best case must be limited to a very few years of active work. Probably the least of the one

thousand veins known to exist on the Mariposa Estate would be considered cheaply held as a separate ownership at $20,000, even in California. I do not mean to say that ($20,000,000) twenty millions of dollars should therefore be the estimated value of the Mariposa Estate, since, in my opinion, all mining properties should be held at a low valuation, so that the capital put at peril in them may be speedily returned. But this mode of viewing it, will enable those to whom the subject is new, to see that it is quite easy to predicate great values upon such a property, in a perfectly legitimate manner, and still be, in a sense, within the limits of truth and probability—and this view becomes all the more impressive if we reflect at how high a valuation many individual mines, upon limited areas, are held

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III.—OF THE FORMER MANAGEMENT.

From what has been said already, and much more might with truth be said to the same end, it cannot be gainsaid, by any one competent to deal with the facts, that the Mariposa Estate exposes more gold-bearing quartz than any other equal area in California, and has within it the capacity for development of more paying mines of gold than any other.

Its history, from the date of the Alvarado Grant to the organization of the present Company, has been

a romance—sometimes a tragedy—which yet remains to be written—every person who has had to do with it has been fascinated by it. Those who have gone upon the Estate persuaded it was a myth or a swindle, have remained only to find themselves numbered among its eulogists, and to feel convinced that the half had not been told, and that a century hence, however industrious the miners may be who explore its golden threads meantime, there will remain yet other productive mines to explore upon it. The history of its failures is instructive, but it is not our purpose to record it. That a great company who had paid for it a nominal sum of over ten millions of dollars should go into its development on a large scale, with a very inadequate working capital, assuming not only the liability of the bonds issued in part payment for the property, but assuming likewise untold debts,* the sequalia of former mismanagement of the mines, and yet expect to succeed, is one of those financial enigmas which will never be explained to the satisfaction of the

* The transfer of the Estate in 1863 to the New York parties was made subject to an underlying title of record, which was not quieted until it found satisfaction in the present organization of the Mariposa Land and Mining Company.

The "mismanagement of the mines" referred to above, alludes to the robbery of the reserves of ore just before the sale to which reference is made in my Report of 1864. (See this Company's volume, pages 79, 80.)

average understanding. That the values which were predicated on this Estate beyond its original capital stock, as well as that stock itself, have not been sunk and completely extinguished, but have to-day in good degree an existence in the Mariposa Certificates and Common Stock of the existing Company—surviving even the sheriff's hammer and the clutch of the receiver—and rising Phœnix-like from the ashes of what would seem to have been a total destruction, is only a new proof that men have become convinced that, in spite of disaster and mismanagement, there are substantial values there which must come out in solid form at the proper time, when the progress of industry, science and art shall have brought together and combined the elements of success.

The ten years which have passed since the first Mariposa Company of New York undertook the Estate, upon such an unsound basis, have been marked by improvements in the mechanical processes of mining, in the method of metallurgical treatment, and in the social elements of labor, which have put a new face upon the entire business, and rendered simple many things which before were difficult, and easy others which were doubtful or impossible. The management of Mr. Olmsted has been criticised in an unfriendly spirit by many as a main cause of the failure of the old Company. Those who know how honest, how untiring, how intelligent

his administration was, cannot admit the justness of such criticisms. Called on to make bricks without straw, and to render self-supporting these vast estates, with the burden of a large and costly staff, a heavy annual interest upon debentures, and the embarrassments of traditions, against which any new comer was almost powerless, it must be conceded that he accomplished great things, and had he been ably seconded and sustained at home, that he would have carried the estate safely to a self-supporting and productive condition.

But at the critical moment he was deserted by his directors ; his bankers in California became naturally alarmed at the apathy shown by the parties in New York, and for want of a less sum of money than was at that moment in the batteries of the quartz mills, the estate was thrown into the hands of a receiver, and he compelled to confess judgment, for a debt not due for months, of not half the amount of the personal values then upon the property. He had overdrawn his account in the Bank of California, by a sum less than his credit, to lay in, before winter rains, needful supplies for the Company stores, to meet which he had, beyond his credit, guaranteed by the New York Company, the bullion in his batteries, and which proved to be considerably more in value than the sum for which the bank made its attachments. A more

melancholy picture of folly cannot be found in the administration of a great property than was this needless collapse of the Mariposa Company in 1865.*

Of the intervening period, up to the organization of the present company and the clarification of the titles from all clouds previously resting on them, it would be profitless to speak. Many valuable documents relating to the property have been scattered and lost during the disorders attending its possession by receivers ; but, fortunately, enough of the maps and plans have been saved to enable the writer to connect his own personal knowledge of the former explorations with the present condition of the work. The great natural features of the Estate remain unchanged ; the chief mines which gave it its reputation are still substantially as they were at the close of Mr. Olmsted's administration ; the Merced dam has been swept away twice, but

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* Mr. Raymond, U S. Commissioner of Mines and Mining, in his Report for 1868, thus characterizes this ruinous policy, in his chapter "on the Wealth and Resources of the Mariposa Estate": "If the Mariposa Company had gone ahead when it stopped, it might have paid its own debts. If it had sold all its personal property and half its mills at auction, it might have paid Mr. Dodge and been better off than it is, after just emerging, breathless and almost lifeless, from his clutch. Before the stupendous folly of the "compromise" of 1865, all previous mismanagement dwindles into insignificance."

has now been again rebuilt in a much more commanding position and in a more substantial manner; the mills driven by its power—three in number, with 105 stamps—have, also, been in part rebuilt, and are now ready for action, or can be easily put in condition; while the approaches to the Estate have been made easy for passengers and freight by the extension of the line of railway from Oakland to the town of Mereed City, within twenty-five to thirty miles of Mariposa. It is proposed at no distant day to extend this road by a branch up to the estate itself.

IV.—CONDITION OF THE MINING INTEREST ON THE PACIFIC SLOPE.

The U. S. Commissioner of Mining Statisties, in his report for 1872, just published, says (page 15): "The business of mining for the precious metals has for the past two years made very marked advanees throughout all parts of the Paeific Slope. Never, within a like period, has this pursuit so strengthened itself in publie confidenee, or undergone so great territorial expansion. At first regarded with distrust and suspieion, it has aehieved the favor of capitalists to a large degree, and ean now enlist their aid more readily than almost any other interest. Mining, instead of being proseribed, as it was at one time, is

now not only recognized as a legitimate pursuit, but is fairly regarded as entitled to precedence over most others. Purged of its follies, and with many of its errors corrected by experience, it opens now not only a more profitable, but a safer field for investment than any other of our leading industries. In no other department of business on the Pacific Coast have the gains for several years past been so liberal or so certain as in this, nor does any other hold out such flattering prospects for large profits in the future. Many of the mineral developments made of late have been enormous and successful.

"It is also the case, that, while mining enterprise has been greatly stimulated of late, it has not to such an extent as formerly been misdirected or overdone —very rarely have recent undertakings, involving large expenditure, been entered on without calculations based on reliable data having first been made, and the whole committed for execution to careful and experienced management. It is not the custom now to build expensive mills or reduction works without something having been first ascertained as to the capacity of the mine whence the ores are expected to be obtained for supplying them. Indeed a good degree of development is insisted on as a condition precedent to considering the question of erecting reduction works, while in most of our large mines extensive deposits are held in reserve, and exploratory labor

maintained well in advance of extraction. In strong contrast with the unfortunate results of the large enterprises set on foot a few years since, are those generally reached by companies who have more recently engaged in quartz and placer mining on a large scale. Then failure was the rule, and success the exception, a condition of things which is now almost reversed, more especially in the State of California."

A few examples of well known mines will serve to illustrate Mr. Raymond's remarks.

1.—THE EUREKA MINE, GRASS VALLEY, NEVADA COUNTY, CALIFORNIA.

This mine has been one of the most steadily productive and best managed gold mines in California, and has few equals in the world. It is on a quartz vein running nearly East and West, with serpentine on the hanging wall. The vein is not large, averaging about three feet, and carrying on an average about $30 per ton. The pay shoot has an extent of about 800 feet, with a southeasterly pitch, which has carried it into the ground of the Idaho, an adjoining property. The original extent of the Eureka ground was 1,800 feet.

From October 1st. 1865, (when the present owners bought the property), down to October 1st, 1872, this mine turned out about 120,000 tons of quartz, giving as follows :

Gross yield in bullion	$3,606,265 91
Mining, milling and all other costs	1,381,614 79
Net profits in 7 years	$2,224,651 12
Expended in purchase of new mines and in construction, and cash carried to surplus	510,651 12
Dividends paid in 7 years	$1,714,000 00
" " 1873, say up to September	280,000 00
" " all	$1,994,000 00

In this mine the mining expenses have always been high.

The average cost of mining 1869–72 was	$8 79 per ton.
" " " milling " "	2 21 "
Cost of mining and milling together	$11 00 "

The sulphurets in this mine have been carefully treated; they do not average after concentration quite one per cent. of the ores mined. They have been treated by chlorination, and yield

An average of	$160 00 per ton.
Cost of concentration $16.27, and of reduction $21.11, or in all	37 38 "
Showing a profit per ton on the sulphurets of	$122 62 "

From this statement it will be seen that for the entire period of nearly 8 years the dividends on this mine have averaged $250,000 annually. In 1870 the amount divided was $400,000. In 1871 the mine became poor from the cause named, but, by prudence and energy, it has in a good degree been restored, and the prospects of the future are now good. It is

easy to understand that if the Eureka Company had owned the ground adjoining them, now held by the Idaho, that they would have been able to increase in place of temporarily suspending dividends, for the Idaho has taken out $80,000 monthly on the same ore shoot which came in from the Eureka. In 1870 the net earnings of the Eureka were almost exactly 66 per cent. of the gross product in gold.

2.—THE SIERRA BUTTES MINES, SIERRA COUNTY, CALIFORNIA.

These mines are of interest both from the length of time they have been worked and their steady returns, as also from their close resemblance to the mines on the Mother Lode on the Mariposa Estate, and especially to the Pine Tree and Josephine, in average value in gold, size of the veins, and advantageous situation for economical mining and milling by water power and gravity.

In 1869–70 this property passed into the hands of an English company. From 1857 to 1869, both inclusive (13 years), we have detailed returns of these mines showing:

Gross amount of bullion obtained		$1,835,525
Cost of mining and milling, etc	$676,338	
Difference to other account	20,187	696,525
Paid in dividends		$1,139,000

The bullion obtained since the property changed

hands was, for 1870–71, over $600,000; for '72–'73 I have not seen the returns, but they probably are not less than $800,000, making the gross product of these mines to date about *three and a quarter millions of dollars.* Its stock was quoted in London, August 9th, £3.10 for £2 paid, an advance of 75% on the par. It has paid its English owners in all £1.4s. per share, or twelve dividends of 2s. per share on 112,500 shares of £2 par. This corresponds to £135,000 paid in dividends to June, 1873, which will make the total dividends paid by the Sierra Buttes mines about $1,800,000. It is believed that $250,000 were taken from these mines prior to 1857. In 1871, 33,200 tons of its quartz yielded $389,000, or $11.71 per ton. The mining cost $3.77; the milling, 95½c. Counting the returns from the tailings the net saving per ton was, in 1871, $8.23¾.

The average yield since 1867 has been $12.44 per ton. The stock sold in 1871 in London at £4.10 to £5 per share of £2, par. The quotations of 1873 are under a very depressed market for all mines, and especially all American mines.

3.—THE AMADOR MINE, AMADOR COUNTY, CALIFORNIA.

Few mines in America are better known than the "Amador" of Sutter Creek, long more fami-

liarly known as "Hayward's Eureka." It is upon the "Mother Lode," inclosed in black clay slates, like those in which the Princeton is found on the Mariposa Estate.

Reference has been made particularly to the likeness in these two mines in another (subsequent) chapter. The vein is here double, as the mother vein always is, wherever I have seen it. The main vein is on the hanging wall, which is harder than the foot wall, owing to the baking it received by a green stone dyke near by. Beneath this vein is another, familiarly known as the "boulder" vein. These two veins are commonly separated by a seam of slate, but not uniformly so, as the two not unfrequently run together. I mention these facts in passing only to call attention to the similarity of this vein of the Amador to the mother lode elsewhere, and especially on the Mariposa Estate. Its course is northwest, and it dips east about 70°. In width it varies from two or three to twenty feet. When I saw it in the 1,100 feet level, it was about fifteen feet, and worth about $20 per ton in gold, although in the upper stopes it was only about $8—sometimes less. The extreme depth on the Amador is 1,300 feet from surface on the slope of the lode. The quality of the quartz has steadily improved with each successive level below a depth of 500 feet. There

are only 1,800 feet of ground on the line of the vein in this mine. It has been steadily worked since 1852, and until 1868 was exclusively an individual ownership.

It is therefore impossible to obtain exact data of its productiveness, except in a general way. It was often spoken of as the "richest mine in California," and as producing net $50,000 monthly. I am persuaded this last statement is an exaggeration, and the other is not now true, great as it undoubtedly is. We know pretty well the amount of ground opened, and the strength and tenor of the vein in the older workings, and from these data I conclude that prior to 1868 the total product of the mine has not exceeded $3,000,000 (three millions of dollars), although it is set down by Mr. Ross Brown, in his report of 1868, as having produced much more.

In 1868 this mine was sold to a new company for $750,000, and put in a stock of 3,750 shares of $400 par on a capital of $1,500,000. The Amador Company had, in 1871, paid in dividends $860,050, or $232.50 per share, its stock having been quoted as high as $390 per share (in April, 1871). This mine has steadily improved in its tenor of gold with every increase of depth, $22 per ton having been obtained from it in mill—the vein being from 10 to 18 feet in width—and all of it sent to mill. It

rarely shows free gold. Its sulphurets yield from $100 to $120 per ton after concentration, and are all treated by chlorination.

The cost of sinking the north or new shaft in 1871 through a depth of 985 feet was about $33 per foot ($33,299.88 in all), including lumber, timber, smith's work, lights, powder, labor, &c., and also turning off three levels. This work was all done in eleven months—two months having been lost in consequence of a strike.

These facts are of special interest to the owners of the Mariposa Estate in view of the proposed new shaft on the Princeton. This new shaft on the Amador is 1,300 feet in depth from surface, and the vein at the bottom ten feet in thickness.

The Amador mines are soon to be supplied with water power to drive their mills, at ten cents per inch (an inch there means one horse power), reducing the cost of running from $35 the stamp to $16 the stamp. At Ophir mills, on the Mariposa Estate, this item is reduced almost to zero.

4.—THE BULLION PRODUCT OF THE UNITED STATES FOR THE YEARS 1869 TO '72, AND OF TWO MINES IN NEVADA FOR 1873.

The bullion products of the United States have been carefully compiled by Mr. Raymond, and we append, from the *Mining Journal*, the amounts produced for the years from 1869 to 1872, inclusive.

	1869.	1870.	1871.	1872.
Arizona	$1,000,000	$800,000	$800,000	$625,000
California	22,500,000	25,000,000	20,000,000	19,049,098
Colorado	4,000,000	3,675,000	4,663,000	4,661,465
Idaho	7,000,000	6,000,000	5,000,000	2,695,870
Montana	9,000,000	9,100,000	8,050,000	6,068,339
Nevada	14,000,000	16,000,000	22,500,000	25,548,801
New Mexico	500,000	500,000	500,000	500,000
Oregon & Wash'n.	3,000,000	3,000,000	2,500,000	2,000,000
Wyoming	.....	100,000	100,000	100,000
Utah	.....	1,300,000	2,300,000	2,445,284
Other sources	500,000	525,000	250,000	250,000
Total	$61,500,000	$66,000,000	$66,663,000	$63,943,857

The decline of over two and a half millions in 1872 is attributed to the decline in the workings of shallow placers in California and the territories, while the permanent works (quartz mines and hydraulic mines) have made increased returns, especially the silver mines of Nevada, which have increased 11½ millions since 1869. The product of 1872 was about equally divided between gold and silver mines, if the bullion of the Comstock lode is reckoned in the latter class. Mr. Raymond says: "The transition from precarious surface mining to organized, permanent and extensive work is going steadily forward. Every year witnesses a substantial gain; and though the aggregate production may fluctuate, there is no real retrogression, but a constant advance, in this most important industry."

The great increase in the two last years in the product of the Comstock lode is largely due to the discovery of an immense body of ores at a great

depth—1,200 to 1,500 feet—far below all former "bonanzas," and differing from all former ores in being much richer in gold. Since January of this year the Belcher and Crown Point, the two mines upon this great body of rich ores, have paid the following dividends:

	Belcher.		Crown Point.
January.....	$312,000	....	.....
February.....	312,000	....	$300,000
March.....	416,000	....	300,000
April.....	520,000	....	500,000
May.....	832,000	....	1,000,000
June.....	1,040,000	....	1,000,000
July.....	728,000	....	400,000
August.....	832,000	....	400,000
	$4,992,000		$3,900,000

This great value of nearly nine millions dividends in eight months has been the product of ore ranging from $30 to $85 per ton in different months, from 15,000 to 16,000 tons in the aggregate from each mine being worked monthly. The quarterly averages per ton of value in these two mines for 1871 and 1872 have been as follows:

	1871		1872–3
March.....	$21.28	....	$52.42
June.....	37.81	....	50.10
September.....	30.56	....	32.16
December.....	33.85	....	31.79
March, 1873.....	.....	....	57.80

Since March the averages of these mines have been considerably higher, and much above the general average of former years.

From the annual report of the Crown Point Mine we draw a few figures showing the progressive development of this mine for three years ending May 1st, 1873:

	Tons Worked.	Bullion Produced.	Dividends Paid.
1871.....	21,087. 660–2,000	$472,181.48	.....
1872.....	80,567. 680–2,000	3,503,633.30	$1,260,000.00
1873.....	126,893.1,290–2,000	6,442,785.02	2,180,000.00
Totals...	228,549. 630–2,000	$10,418,599.80	$3,440,000.00
On hand, May 1st, 1873.....			1,873,891.41

The average value obtained from the ores worked was, for the last year, $46.32 per ton, representing about 65 per cent. of the gross value in the ore. The present value is over $80 per ton, and the bullion obtained has about 45 per cent. of gold value, and 55 per cent. of silver value. The cost of mining the ore is $8.63 per ton, and of milling $11.74, making $20.37 per ton, or about 56 per cent. of the gross product.

The milling of ores in Washoe, by what is known as the Washoe silver process, is a more costly affair than is the reduction of gold quartz, owing both to the fact of the process itself being more expensive, and that the mills are mainly owned by outside parties.

The recent history of the Belcher and Crown Point mines affords the most striking illustration which can be found of what has been said on former pages of this communication, respecting the mode of occurrence of bodies of ore of the precious

metals, in what are commonly called chimnies. These are in form of flattened ovoidal masses, standing in the course of the vein, with the smaller end of the egg uppermost, and widening out gradually as they go down in depth, both across the vein and lengthwise. These ore bodies succeed each other in depth, with intervals of poor or barren vein-stuff between them. Thus, in these two mines, now working on one and the same great ore-body, prior to 1870 the former rich chimney, which at an earlier day gave them high repute, had become so far exhausted that their shares were offered at the most nominal price, without purchasers. Meantime the work of exploration in depth was courageously pushed, under great discouragements.

The new ore body was at last found on the 900 feet level, and was at first a narrow seam, gradually widening from nine feet until, at the depth of 1,300 feet, on the first of May last, it was ninety feet in width, and had a longitudinal extent in both mines of 670 feet. Its limits on the line of the vein have not yet been reached, nor in width by a long way. This very important ore body was not discovered until a depth had been reached greater than that at which all the earlier ore bodies on the Comstock lode had been exhausted.

The result of this recent discovery seems to those not acquainted with the facts almost incredible

The natural effect has been to stimulate deep explorations on other mines adjacent, in some of which there appear to be good reasons to anticipate the occurrence of like ore bodies, at greater depths than have hitherto been esteemed practicable—but not greater than those which the River Tunnel on the Mother Lode lays open to the Ophir Mills on the Mariposa Estate. It is foreign to our purpose to say anything more of the Comstock Lode, in this connection, than is needful to illustrate the main points sought to be set forth in this statement of facts, and of the principles which they illustrate, of the mode of occurrence of ores in fissure veins—and as illustrating, also, yet further, what has been said of the present condition of the mining industry on the Pacific side of the Continent.

One remarkable fact with regard to the enormous dividends now paid on the Nevada and California mines is the total absence of any speculative movement in the stocks of the mines, from which such great results are obtained. These mines have earned and paid, over all expenses, this year thus far, 54 per cent. of the par value of their stocks, and yet the shares are quoted under par. This is the natural reaction from a period of wild speculation, two years since, when the immediate prospect of these great results gave an almost unprecedented activity to speculative sales in these very shares,

carrying them up over a thousand per cent. above their par value, to the great injury of the best interests of legitimate mining industry. These mines appear now to be worked solely upon their intrinsic merits, and the fact is fully recognized that their future value is not benefited by what has already been taken from them, and that their real value is to estimate upon a fair computation of their visible reserves, which are believed to be worth to-day some twelve to fifteen millions of dollars—which is about the selling value of their shares. Of course, those who hold them at the almost nominal price at which they were sold three years since, have already amassed fortunes, and can well afford to disregard the present value of their shares—counting their reserves as so much coin in bank.

V.—WHAT TIME AND INVENTION HAVE DONE IN LATER YEARS TO SIMPLIFY AND CHEAPEN MINING PROCESSES.

Since 1865, when the old Mariposa Company suspended, many very important improvements have been made in the mechanical methods of mining, by which the processes of driving tunnels, sinking shafts, stoping and exploring, have been very greatly cheapened and facilitated. The labor question has also undergone changes much to the advantage of

owners; for not only is white labor paid less than formerly, but the Chinese have proved themselves to be excellent workmen, both above and under ground, at rates less than one half those now paid for white labor.

These changes amount in fact to a revolution. It is now possible to explore mines at a profit which, under former conditions, could be worked only at a loss.

The time consumed in making explorations has also been greatly shortened by the mechanical drilling machines—certainly one half—while, by the introduction of the use of compressed air as a mechanical power to drive these machines, it is made safe and easy to carry long tunnels into mountains by the excellent ventilation thus obtained, while the sudden expansion of the compressed air also reduces the temperature at the point where work is being done, greatly to the comfort and efficiency of the miners. These improvements may be thus stated:

1st. The mechanical and percussive drilling machines.

2d. The air compressor, which drives them and ventilates the work.

3d. The Diamond Exploring Drill.

4th. The single hand drill and Chinese labor.

5th. The new and more powerful explosives used.

Let us consider these improvements somewhat in detail:

1.—BURLEIGH DRILL.

The results obtained with the Mechanical Drill of Burleigh at the Government works at Hallett's Point are the most important and satisfactory which have been reached in any mining operation in this country, and are probably not equalled elsewhere in the world. These works I have inspected. The object of this exploration is to undermine an area large enough and deep enough to receive and engulf the whole of the present shallow bottom of that dangerous reef, so as to give a clear depth at low water of 26 feet.

The rock is a hard gray and blue gneiss, standing vertically on edge, the line of strike being about northeast and southwest. From the bottom of an open pit, sunk on the shore to the depth of about 50 feet below the edge of the coffer dam, which shuts out the ocean, and which pit is a semicircular area of about 50 or 60 feet radius, are some twelve galleries, run out like the spokes of a wheel over an area of something over two acres in extent. These galleries are intersected at regular distances by other galleries sweeping in curves of a circle, of which the first named galleries are the radii, thus leaving the roof of rock under the sea supported by a series of columns. When the bottom of these works has been carried down to a suitable depth, the area of the supporting columns will be

diminished as much as safety will permit, and alternate columns will be withdrawn altogether. Then a series of nitro-glycerine cartridges will be arranged throughout the entire mine, all connected by insulated wires with an electric battery, at a safe distance, the sea will then be let in to fill the whole excavation, and the entire series of charges of nitro-glycerine simultaneously exploded. The roof will fall, and its fragments find a resting place in the cavities of the mine. Such is a brief outline of this important national work, which is interesting to the owners and management of the Mariposa Estate only from the important experimental data it furnishes in the use of the Burleigh machine-drill and the powerful explosives, all of which have been used here. The engineers prefer nitro-glycerine freshly made day by day, as wanted for immediate use, as it does a fourth part more work than the same amount of Giant Powder. They have in two and a half years employed about 32,000 pounds of nitro-glycerine, at a cost of $1.10 per pound, in about 70,000 charges, and with it have mined about 40,000 cubic yards of rock. This explosive has been fired mostly in machine drilled holes, hand drilling having for a long time been almost completely disused in regular progressive work. The average work done by the Burleigh machines, ten of which are regularly in use (two supplemental

machines being kept on hand in the shops, one of which only has been in use for an entire year,) is thirty feet of hole two inches in diameter, drilled for each day's work of eight hours. This is an average. In extreme cases eighty feet have been drilled, and in some cases only six feet were made, owing to some accident. This result has been obtained upon ground which is always very hard, and in doing which the larger portion takes the rock in the most disadvantageous position for efficiency, viz., between the laminæ, which stand edges on and upright, like the edges of a book standing on end. The life of a drill point averages nearly four feet, (3:8) without sharpening. They strike about two hundred blows a minute. The blast holes are made about thirty-six inches deep, so that one sharpening in this hard rock is more than sufficient to bore one hole, ten of which form the work of eight hours. Each drill strikes about ten thousand blows in making a hole of this depth, and sinks three quarters of an inch per minute. One smith sharpens and tempers, with the aid of one striker, one hundred drills daily, which is the number used by the ten machines, which makes the cost of each sharpening and tempering about six cents. The cost of driving in this very hard rock is no criterion for the cost in a rock as readily drilled as the Mariposa slates, where the

drill of this machine was driven thirty-two inches in two and a half minutes on a trial, which gave, of course, much more than an average of regular work. But we are yet without a sufficient experience to justify any statement as to the average rapidity of progress in the River Tunnel. We may say, however, it has been, so far, much in advance of any progress hitherto made in any other mining tunnel of which we have notice.

Owing to the danger incurred in exploding all the blasts of a heading simultaneously by electricity at Hallett's Point (a course which they were compelled to abandon, owing to the risk of opening up the vertical seams of the rock to the ocean above, and causing a rupture which would be fatal), they are compelled to fire *each charge separately*. The engineer in charge expresses the conviction that the loss by this is fully one half of all the time, labor and explosives used. Holes half the depth, with half the nitro-glycerine, or double the depth with the same charge of explosives, would do the same work to which they are now necessarily restricted. With all these disadvantages, the comparative cost of hand drilling to machine drilling here makes the advantages of the latter over two to one to the hand work. The violent prejudices of the old miners against the machines have completely disappeared, and they quickly learn to use them with skill; and as their

wages are in a measure made dependent on their driving a certain number of feet in each tour of eight hours, they use the machines with care and efficiency. Comparing merely *rapidity of work* done by the machine drill as to hand drills, the result is as five to one; the time lost in running the machine out for exploding, and withdrawing the *debris*, reduces this ratio, so that the relative efficiency and economy combined is as 2 : 1.

The average cost per foot of rock drilled at Hallett's Point has been thirty-five cents, with six machines. Of this the cost of steam power to compress the air equals ten cents per foot. If we compare these results with those obtained at Hoosac Tunnel in the infancy of the mechanical drill, we shall be surprised at the vast improvement in the economy and efficiency of these machines. Those now at work on the "River Tunnel" of Mariposa are of the latest pattern, and are mounted on an improved carriage, which allows of the use of two machines working side by side. By the use of a stream of water, to wash out the holes and keep the drills cool, one man can feed and manage each machine, yet further reducing the cost of the work. Two machines may not do twice the work of one, but very nearly so, while they will reduce the cost of most items one half.

It is easy, from this review of well ascertained facts, to see that the improvements introduced in the

last few years in the mechanical means at the disposal of the mining engineer have completely changed the face of such enterprises as those now in progress on the Mariposa Estate, and banish or transform all the old elements of calculation. This change is due to the perfected mechanical drill, to the use of compressed air for a power and ventilation, and to more energetic explosives.

On this last head it may be well, in passing, to say that nitro-glycerine differs from Dynamite or Giant Powder only in the fact that the Giant Powder is infusorial earth saturated with nitro-glycerine, which diminishes the weight of nitro-glycerine in a given weight of Giant Powder by one quarter, so its energy is only three quarters as great as that of nitro-glycerine.

In great operations, where they use from seventy-five to one hundred and fifty pounds a day of nitro-glycerine, it is no doubt better to use that explosive (which has been used thus far at Hallett's Point without any accident); but where only a small amount is used daily, it is probably better to use Giant Powder, as it does not so rapidly change, as the simple nitro-glycerine does, and it is this change which renders it dangerous.

2.—THE AIR COMPRESSOR.

This machine gives motion to the Burleigh Drill, and is itself driven by the water power of the

Merced River, near the mouth of the River Tunnel. Experience has abundantly proven, in the case of the Mount Cenis Tunnel, the Hoosac Tunnel, the explorations of Hell Gate, and at many other places, that compressed air, at a pressure of fifty to seventy-five pounds (three to five atmosphere, or thereabouts), may be transmitted without sensible loss, in tubes of iron, to almost any distance required. In a line of over seven thousand feet, at Hoosac Tunnel, the loss of power was only about two pounds pressure, with an initial force of about sixty-five pounds at the compressor. The use of air as a motor has the very important advantage that it effectually *ventilates the mine*, and renders it possible to mine long tunnels, with health and comfort to the miner and economy to the owners.

The use of water power to drive the compressors is an important further economy on steam. Experience shows, as already mentioned, that the cost of steam power to compress air at Hallett's Point is ten cents for each foot drilled—the total cost of drilling, power included, being thirty-five cents per foot.

The air compressor of the Burleigh Company is a compact and economical apparatus, working two air pumps, made of three sizes (Nos. 1, 2 and 3), compressing at ninety revolutions per minute—90, 177 and 267 cubic feet of air per minute, respec-

tively, to the standard pressure of five atmospheres. The compressed air is retained in a tank or reservoir of iron, like a cylindrical boiler, and it is carried from the tank to the point of work by iron pipes, as steam is carried (saving the condensation). A flexible rubber pipe connects the drilling machine with the permanent pipes. It is not an unimportant circumstance in a hot country, or in *deep* mines, that the expansion of the compressed air, in its escape through the machine, has the effect materially to lower the temperature of the tunnel, which serves to remove the heat from the candles and the human beings present.

Regarded in all its applications to the various modes of mining, the air compressor must be esteemed as one of the greatest steps, in advance of old methods, made in mining in modern times; and by its use the gold bearing veins on the Mariposa Estate can be rapidly, and, as compared with former experience, cheaply explored, at depths and distances hitherto quite unattainable for the want of this very important agency. This is true equally of stoping ore as of driving tunnels, permitting us to work overhead to an extent before impossible, without a shaft or winze leading up to the outer air. With stopes of over a thousand feet above the tunnel the importance of this facility can readily be seen.

3.—THE DIAMOND EXPLORING DRILL.

The Burleigh Drill is a *percussion* drill, probably the best of its class, and certainly a most efficient apparatus, which I believe is destined to do wonders on the Mariposa Estate, as it has elsewhere.

M. Leschot's *Diamond Drill* is a machine of a very unlike action, since, by the use of brute diamonds set on the end of a revolving borer, it *cuts* an annular space, or cylindrical hole, out of the hardest rock, with surprising rapidity, while the smooth cylindrical core, is saved, when the annular cutter is used, in convenient lengths, and thus gives a *perfect section* of the rock it bores. As a means of rapidly and economically prospecting or testing mineral deposits it has no rival. Its inventor and his American assignees (Messrs. Severance & Holt) claim for it much more than this—that it is an instrument as efficient as any other mechanical drill for proper mining work. We will not now pause to discuss its merits in this respect; but I desire to point out its great advantages as an agent of rapid and cheap *exploration.*

This drill, like the Burleigh, is driven in mines by compressed air. In open quarries it is often driven by steam. The drill is an iron tube, boring holes from two to five inches in diameter, as desired, and to any desired depth. The cutting diamonds are set in the substance of the end of

the tube or cutter in little cavities, the metal being firmly upset or hammered to hold the diamonds. These stones project about half a milimetre (the thickness of a card) above the metal, and also slightly beyond the outer and inner diameters of the tube and ring which holds them in place. The tube is about a quarter of an inch thick. A rapid rotation is now given to this cutting instrument, while a stream of water is forced by a pump down the centre of the bore, to avoid heating the cutters and to clear away the powdered rock. The result is that the rock against which it is pressed by the "feed" of the apparatus is cut away, whether it be soft or hard—clay, slate, limestone, granite, porphyry, or crystal quartz—with a truly surprising rapidity. The hole it makes is truly cylindrical, and the *core*, which is removed by reversing the motion when the drill is withdrawn, is as smooth as a well moulded candle.

The rapidity of boring depends, of course, on the character of the stone, varying from five feet an hour, in very hard rock, to fifteen feet per hour in softer rocks. The rate of boring appears to be limited only by the rapidity of revolution which can be imparted to the drill. The rate of "feed" is from 300 to 400 revolutions to the inch cut. With 400 revolutions the diamonds cut only the $\frac{1}{400}$th of an inch per each revolution, which is the rate of

the very hardest rocks, and with a speed of 1,000 revolutions the drill would, it is claimed, bore the hardest rock at the rate of 8 to 10 feet per hour. In soft rocks, like marble, slates, &c., the rate of speed in drilling is much greater. So much harder than any other stone is the diamond, that those which have cut through 2,000 feet of hard rocks show little wear. The cost of resetting diamonds, so as to present new points, is small, and requires no special skill. The diamonds cost from $6 to $7 per carat (24 grains) *gold*, and are worth when rejected half *their* cost for lapidary use. The usual diameter of bits for drilling blast holes in mines is one and a half inch, carrying six diamonds. The black diamond, called "carbons," is usually set, but sometimes translucent stones, called "borts," of no value as gems, are used.

The diamond drill is so shaped that the tool never gets out of line when the annular bit is used, hence the hole, however deep, is always quite straight, and there is no friction of the drill stock against the sides of the hole. Cylinders or cores of rock have been frequently taken out from a depth of over 500 to even 800 feet, giving a perfect record of the succession of deposits and veins passed through.

In the magnetic iron ore beds of Witherbee, Sherman & Co., in Essex Co., N. Y., this drill was sunk to a depth of forty feet, in a very hard rock, with

hard iron ore, thus revealing the nature of the mine to that extent. At Portland, Connecticut, it became necessary to know, before purchasing some adjoining property, if the famed "brown stone" of the Connecticut Trias held good, or was (as many supposed) undercut by the crystalline rocks, which are there close at hand. The diamond drill revealed by its cores continuous sandstone to the depth of 312 feet, and the adjoining estates were purchased on its testimony.

In Pennsylvania, at the William Penn Colliery, the mammoth vein was prospected by a core cut to the depth of 105 feet, sunk from the bottom of a shaft which was down already 170 feet, the entire work being done in six hours and forty-seven minutes actual running time. Of this, 46 feet 1 inch was through slate and coal alternately mixed ; and 58 feet 10 inches through anthracite coal, the bed dipping at about 45 degrees.

The average rate of boring was 3.06 per minute for the whole depth, or 15½ feet per hour.

The drill in its passage cut balls of iron pyrites of intense hardness, of the size of a large goose egg and larger, with the same facility as it cut conglomerate rock. The same machine was subsequently used by the proprietors to bore blast holes, which it cut at 22 inches per minute, while the most experienced miners could drill by hand only

five feet per hour ; this is as 22:1 in favor of the diamond drill.

The Reading Railroad Company are now sinking two immense shafts on E. Norwegian property, so called, near Pottsville, designed to eut the mammoth vein at the depth of about 1,200 feet. In this work, whieh is the most important mining work of its kind ever undertaken in America, the diamond drill alone is used. General Henry Pleasants, who is in charge of the work, in his report of February 12, 1873, says: "The east shaft is 530 feet deep, and the west shaft 261 feet. The best blasting has been eighty feet per month, the best drilling seventy-nine feet in twelve hours. The average depth of the first drillings in twenty-five holes was 254 feet, and in the west shaft thirty-seven holes averaged each 284 feet. The diamonds lost and worn were, in the first named shaft, borts, eight earats ; earbons, 66½ earats. In the second shaft, borts, 30¼ carats ; and earbons, 192½ carats." The total depth of these borings were, respeetively, 6,350 feet, and 10,508 feet—equal, in all, 16,858 feet—about three and a half miles—making the cost of wear and tear of diamonds equal 15½ eents per foot of roek bored. Mueh of the gronnd bored at the east Norwegian shafts is a eompaet eonglomerate, very hard on the diamonds. A roek of uniform hardness is better ground for boring than one of unequal hardness.

The Leschot Drill was introduced into California in 1870, to explore Carson Hill and elsewhere. The Company sunk several holes on the Union mine at an angle of 45°, going down 120 and 317 feet. The rock bored was slate mixed with quartz. The drill sunk as high as seventy feet in a single day of ten hours, in slate, with strings of quartz through it. In five hours thirteen feet of white crystal quartz was bored. This was the hardest rock bored in the mining districts.

In a tunnel belonging to the Bullion Consolidated Mining Company in Colorado Territory the Diamond Drill of Leschot was set to work, 600 feet in from day, and, moved by compressed air, drove in a bore hole horizontally 417½ feet in advance of the tunnel, bringing out a core to show the nature of the rock for the whole distance, revealing the existence and position of two silver veins not before known.

These examples could be much multiplied, but enough evidence has been adduced to show how large and promising a field there is for operations of this sort on the Mariposa Estate.

For instance, from the River Tunnel, now in progress, it will soon become important to know the value of the quartz veins, the croppings of which are so conspicuous at numerous points along the ridge before reaching the Pine Tree Mine.

This tunnel runs alongside the veins, not in them,

but at a safe distance under them in the foot wall slate. To bore through these intervening slates and the vein or veins, bringing out a core to prove the thickness and value of the quartz, and to determine when and where to run a crosscut for its extraction, will be a work which can be accomplished at the rate of at least four or five feet an hour, so that one full day of twenty-four hours will probably suffice at once to test the vein and guide the direction of the tunnel.

By recent improvements in California the Diamond drill has been greatly perfected, and has come into general use in running what are known in California as *bed rock tunnels*, in preparing ground for hydraulic mining. The latest improvement hitherto is in running these drills by water power in place of compressed air. The water is introduced by pipes, and is applied to a "hurdy gurdy," or small turbine wheel attached to the rear end of the car which carries the drills. This car runs on the same track with the rock car. Ten or twelve holes are bored in the end of the tunnel, and simultaneously exploded by electricity with Giant Powder—as many as 663 cubic feet of rock, or fifty tons, have been obtained at a single blast of twelve holes, in a tunnel $6\frac{1}{2}$ by $9\frac{1}{2}$ feet. The amount of water required for this mode of driving drills depends on the head. Where there is no ditch at a suitable elevation, as there is not

on the Mariposa Estate, water may be forced up by a Knowles pump to any desired height to a reservoir, and for this purpose the water and water power of the Merced afford every facility, and the hills any desired degree of elevation. This method of using the Diamond Drill is now in use in Nevada, Placer and Butte Counties, California, in several bed rock tunnels; and the same plan has been adopted in the Sutro Tunnel in Nevada, which is driven to cut the Comstock Lode 20,000 feet from its commencement.

Without extending this chapter, it is evident from the facts cited that the Diamond Drill, as a prospecting instrument and for sinking deep shafts, has opened a new future for mining in California.

It is needless in this connection to go into the details of its use farther than to say that its efficiency is greatly increased by the use of simultaneous discharges of Giant Powder or nitro-glycerine, and by the air compressor, for power and ventilation.

4.—THE HAND DRILL AND CHINESE LABOR.

Mining labor of the better sort, by Cornishmen and by Americans, has been, especially in California and Nevada, very costly labor, the wages of such laborers varying from three to five dollars, gold, per day, according to locality. As mining is, very largely, labor, it follows, of course, that any impor-

tant decrease in the price paid for labor, must have an equally important effect on the prosecution of explorations. It has been the practice in most cases, in drilling holes for blasting, to employ three men to a hole, two to strike and one to hold the drill. The German miners, who are the most economical workers in Europe, centuries ago discovered that, in hard rock, single drills of small steel are more effective than large drills, and at a less cost. Now, since the introduction of quick and powerful explosives, like dynamite or Giant Powder, nitro-glycerine, etc., single hand drilling has become much more common than hitherto in all parts of California. In this mode of exploration the same man holds and strikes, and in many situations such labor is found to be particularly effective. The cost of running tunnels in hard rock in Nevada County was reduced 25 to 33 per cent. by the introduction of single handed drills and Giant Powder before the mechanical drilling machines were introduced.

The Chinese have proved themselves, wherever they have been fairly tried, good workmen. They are noted for their great fidelity and steadiness, and, when promptly paid, they may be safely relied on. Chinese skilled miners are equal to miners of any nationality, whether above ground or under ground. The prejudice against them on account of color and nationality was at one time very strong,

but is now in a great degree removed. They have long been employed on the Mariposa Estate, where large numbers of them early resorted as placer miners, and it is the policy of the present administration to continue them in the mines under ground. The rate of wages now paid to Chinese miners on the estate is $1.25 per day of ten hours.

Some very just and discriminating remarks on the use of Chinese labor in mining will be found in Mr. Raymond's Mining Statistics for 1871, pp. 3 to 6, and in the same, on Mariposa Estate, p. 28.

5.—GIANT POWDER OR DYNAMITE.

The use of this powerful explosive has become quite general in California and Nevada. It is produced by mingling nitro-glycerine with infusorial earth, and it resembles in appearance moist sawdust. It is exploded by electricity, or by the percussion exploder, and its use permits the drilling of small holes, such as are made by three quarter inch octagonal steel drills, driven by a hammer of 3½ pounds. Owing to its instantaneous quickness, tamping is needless, and this great danger of accident is therefore avoided. It is needless to go into details in regard to this remarkable explosive, the use of which marks an era in mining.

Giant Powder, as before stated, is preferred in

California ; not because it is better or cheaper than nitro-glycerine, but because it is, in common mining, safer. It can be kept long without change, while nitro-glycerine should be used soon after it is made, or it is liable to decompose ; while, if any drops of this violent explosive remain in the crevices of the rocks blown, these are liable to accidental explosion on drilling a new hole.

Experience has demonstrated that in hard rocks holes of three to four feet depth do more execution than deeper ones, and with black powder it is not possible to find room in such a hole for an adequate charge to rend the rocks and have space for tamping, without which the black powder is useless. The Giant Powder needs no tamping, and is about five times more efficient than the same quantity of black powder.

VI.—PLAN OF DEVELOPMENT.

The plan adopted and now in progress for the development of the mineral resources of the Mariposa Estate contemplates the extraction and reduction of its ores in greater abundance, and with an economy, steadiness and permanence before unknown, and not possible, until, by the progress of discovery and development, the new elements of rapid and cheaper exploration could be combined,

as they now may be, to accomplish what these have rendered comparatively simple and easy. By this plan the "Mother Lode" will be reached at a depth more than a thousand feet below any of the former explorations upon it, both by tunnel and shaft. For a time every effort will be concentrated upon two chief and most important undertakings, but the plan also looks much beyond these in the not very distant future. We will speak,

1*st, of the River Tunnel* now in progress, running southeast from the Ophir Mills on the Merced River, and designed to open up the ores of the Mother Lode, under all the numerous croppings along its course, for two miles at least, laying open stopes of from 500 to 1,800 feet, now standing above the grade of the tunnel, all of which will find their way by gravity and water power to the Ophir Mills for reduction, in an abundance which generations of active work cannot exhaust.

2*d. The exploration of the Princeton Mine* (also upon the Mother Lode) by a vertical shaft, set to cut the vein about twelve hundred feet (1,200) below the surface, and giving at least one thousand feet (1,000) of virgin ground below the former workings of this famous mine, and furnishing the means also of drainage and exploration to a very large extent of ore ground, on this portion of the vein not heretofore accessible.

3*d*. The reduction of all ores by water power on the Merced River, where there is ample power for the construction of mills beyond those now existing there. This involves also the construction of a narrow gauge railway for the transportation of the Princeton and other contiguous ores.

4*th*. The future development of some of the other very numerous mines now known to exist upon the estate, to which it is scarcely possible to assign a limit, time and means availing for the work.

1.—THE RIVER TUNNEL.

This work has been laid out from the notes of the late Mr. Rice, by the survey of Mr. R. B. Thomas, Engineer of Mariposa County, with the aid of all the former surveys and openings on the Mother Lode, and with the advice of the Resident Superintendent, E. O. Darling. Its initial point is about 50 feet above the high water mark of the Mereed River, and about 600 feet from the upper mill. Its course is in the main south-east. It is run in the slates of the foot wall at a safe distance from the vein, to seeure steady and easy ground, and to avoid the use of timber. It is $6\frac{1}{2}$ feet high by $5\frac{1}{2}$ feet wide, and is designed for a single track tramway, with sidings or turnouts. It will undereut the Linda Mine (old Pine Tree) at about 6,000 feet from its

mouth, and about (1,150) eleven hundred and fifty feet on the slope of the vein (1,000 feet vertical) below the "main tunnel" of the old workings. The old main tunnel is about 400 feet under the croppings of the lode. From the Linda Mine to the Josephine is about 1,800 feet, making the total distance from the Ophir Mills to the Josephine Mine about 8,750 feet, of which about 8,000 is in the tunnel. Between the mouth of the River Tunnel and the Linda Mine are twenty or more well known sets of surface croppings on the lode, offering so many points where cross drifts may be opened out from the tunnel level for the extraction of ores. These veins show from $2\frac{1}{2}$ to 6 feet thick at surface, and afforded in the early days of the estate very rich ores. The two "specimen veins," so called, are of the number, but they were so situated that they could not be advantageously worked in competition with the enormous developments upon the Pine Tree (now Linda) and Josephine. There may be more chimnies or shoots of ore than are now known along this line. The richest ore ground by no means makes itself seen always at the surface. Hence the importance of exploring, as is here suggested, by the Diamond drill.

Dr. Adleberg, in an early report on the Mariposa Estate, suggested running a tunnel from the Merced

River to undercut the outcrops of the Mother Lode, an idea which has probably suggested itself to every engineer who has looked at the situation. Mr. Olmsted, in 1864, commenced a tunnel upon the outcrops about 50 feet above the present tunnel and 15 feet west of it, and ran in for some distance on the lode, but was compelled to abandon it for want of funds. A stream of water of some size, which has since his time flowed from the tunnel, was lately drained into the river tunnel, which, on the 9th of August, was directly under the Olmsted Tunnel.

The Diamond Drill offers an easy and safe guide in such explorations, bringing out, as it does, a solid core of polished rock, which shows not only the distance, position and thickness of the vein and its relation to the adjoining rocks, but also furnishing a trial sample of its value. By its aid the miner can in a few hours measure his distance from the vein he proposes to explore, and so shape his course as not to permit his main tunnel to wander too far from or approach too near to the mining ground. By it, too, he can tell with certainty where the "chimnies" or shoots of pay ore are, and so avoid the loss of time, expense and disappointment consequent on running exploration tunnels on an uncertainty.

The River Tunnel is now run by the Burleigh Drill and air compressor. The compressor is

driven by the Merced River, and compresses the air to about 50 to 60 pounds per square inch. Two drilling machines are on hand to allow of repairs going forward without interruption to the work. A shop has been erected at the mouth of the tunnel for this purpose and for the sharpening of drills. The carriage on which the drill is mounted runs on the same tramway which is provided for mining use, and on which the broken rock is removed. The car first sent out was designed for a wider tunnel, and at first impeded the progress of the work. But a car of suitable dimensions for the work has since been sent forward, permitting the use of two drills side by side upon the same support, and also allowing of the removal of debris without running the drilling machines away from their work. The thorough ventilation offered by the escape of the compressed air at the headings, in driving the drills, permits the constant presence of men, without fatigue or loss of time from foul air, or the smoke of candles and explosives. On the 17th day of June, 1873, the Burleigh Drill was started in the River Tunnel. On its first trial it bored a hole thirty-one inches deep in two and a half minutes, in slates. On the first of August the River Tunnel was in, one hundred and thirty-three feet from the mouth. For eighteen days, from July 13th to 31st, the advance was

forty-eight feet, or 2.66 feet for twenty-four hours—or about eighty feet per month. With the use of a proper carriage, to avoid the present loss of time, considerably greater progress will be made. The persons in charge expect to make two hundred feet in a month. This is probably an over estimate, and is certainly more than has been done in any other tunnel of which we have notice.

That such a rate of progress is not unreasonable appears from the experience had at Hallett's Point, where, as before stated, for an entire year the average work of the Burleigh Drill, in hard gneiss, was thirty feet in eight hours—the Government day's work. The use of two drills on the same carriage will probably not double the work of one drill in the Mariposa slates, but will doubtless make sixty feet in twelve hours, or one hundred feet in twenty-four hours, and leave ample time for removal of debris. But one hundred feet of drilling is ample for three blastings of 12 three feet holes, each of which would give an advance in the tunnel head of nine feet in twenty-four hours, or, in four weeks —twenty-four days—we should have an advance of two hundred and sixteen feet. Too much depends on the character of the ground to make such a calculation, yet—it may be less, possibly more—time will decide.

Where water power and Chinese labor are used,

as at Mariposa, to furnish the compressed air and remove the debris, the conditions are as favorable as possible, and hence the cost of labor will be diminished, and that of fuel will disappear. So far also the ground has been very favorable for rapid progress. From the known geological structure of the country there is every reason to believe that slate will predominate on the line of this tunnel, alternating sometimes with green stone, which is a large and free breaking kind of rock.

The advantages of exploring this portion of the Mother Vein by a deep down tunnel may thus be briefly enumerated :

1*st.* The cost of mining is reduced to a minimum —no pumping, no hoisting, no costly hauling over a long circuit on the surface with an equipment of men and animals—overhead stopes—no shafts, no timbering. The cost of engines, engineers and fuel will be saved, and in the stopes the Burleigh Drill will replace the old trio of Cornishmen with their hammers and drills. With all these advantages it is confidently expected that quartz can be mined and delivered at mill at a cost of not exceeding one third what it has hitherto cost to mine, and deliver it from the old Pine Tree and Josephine mines.

2*d.* The discovery on this low horizon of numerous new ore bodies not seen above at all.

3d. The opening up of reserves on the known ore shoots or chimnies to an extent never before possible or even contemplated. Some idea of this may be formed from the fact that on the known ore bodies the River Tunnel gives "backs" of from 400 to 2,000 feet on a line of two miles or more. All calculations of the probable volume of reserves in such mines are idle; the proper calculation is the volume of water which can be brought to bear upon the crushing and amalgamation of them; in which respect these stopes over the River Tunnel resemble some of the deep laying placers which centuries cannot exhaust.

It is to be remembered that beneath the horizon of the River Tunnel is a body of ores of unmeasured depth and vast extent, of which no note is here taken.

Mr. A. F. Horn, who is in charge of the operations of the Burleigh Drill at the River Tunnel, has had two years' experience at the Hoosac Tunnel and one year at Hallett's Point in the same service. The wisdom of entrusting such important operations only to experienced men is too obvious to require comment, and is found also in the fact that the expenses of repairs to the machinery have amounted so far only to the most insignificant sum.

In his letter of August 12 to the New York office the Manager says, speaking of the operations

of the Burleigh Drill, "To-day we put in 12 holes 3½ feet deep, and all blasted to the bottom." The blasting is effected simultaneously by the electric spark.

2.—THE "MOTHER LODE" AND ITS MINES ON THE MARIPOSA ESTATE.

It is at Bear Valley, on the Mariposa Estate, that we find the first distinct appearance of that great system of gold quartz veins which, with numerous interruptions, extends in a main line of powerful outcrops to Amador County, California, over seventy miles, and upon which exist some of the most noted and productive mines of the world. Upon this "Mother Lode" exist, on the Mariposa Estate, the "Princeton" Mine, which has turned out nearly four millions of dollars, and the Pine Tree–Josephine Mine, also largely productive, and between them for many miles a series of outcrops, which have been only partially explored.

These outcrops of the Mother Lode are often conspicuous landmarks of white quartz, glistening in the sun from a distance like walls of snow. Such are those seen at Carson Hill, in Calaveras Co.; at Quartz Mountain and Whiskey Hill, in Tuolumne; at Piñon Blanco and Josephine-Pine Tree, in Mariposa.

At other points the vein exhausts without con-

spicuous outcrops, as at the Princeton Mine and the famous Hayward Eureka, in Amador, where they are down on it now over 1,300 feet in profitable ore, the deepest gold mining in the United States, and probably in the world. The "River Tunnel," now in progress on the Mariposa Estate, will, however, open the Mother Lode under the well known chimnies of the Pine Tree-Josephine, at a depth of over 1,600 feet from croppings, and fully 1,300 feet on the Josephine, below any former explorations. The lowest workings yet made upon the Josephine-Pine Tree at the "Black Drift" are less than 300 feet from croppings, and in the Linda (old Pine Tree mine) the lowest workings are about 500 feet from surface.

Experience in sinking on the Mother Lode, has demonstrated that in depths of 1,000 to 1,200 feet it becomes a permanent fissure of from twelve to twenty feet in width, while at the surface it is sometimes seen, as at Quartz Mountain, 200 feet wide or more, with a great "horse" of country rock dividing it into two branches. It is not unlikely that the two branches known on the Mariposa Estate as Pine Tree and Josephine may unite in depth, as we now know they do on going South beyond the Black Drift—a point but lately demonstrated by Mr. Darling, the manager—although I pointed out in 1864 the probability of such a junction, and find in my

note book of that date a diagram showing the probable mode of union, just as it has now been disclosed in 1873.

It is unnecessary to repeat here the mineralogical and geological peculiarities of the Mother Lode, as these are detailed sufficiently in my former report. I would only remark on the important fact that the vein itself varies, in its contents, average value, and mode of distribution of the gold in it, with the nature of the enclosing rocks.

Adjoining the Serpentine, and having that rock for a hanging wall, with slates or green stone for the foot wall, the Mother Lode swells often to enormous dimensions—its quartz being sometimes barren or productive only in streaks, and the whole readily recognized by an experienced eye. On the other hand, in the slates, the vein has a less average size and a higher average gold value—while the character of the quartz is very much changed, embracing thin seams of the slaty substance of the country rock, giving it a banded or ribbon-like structure, favorable to economical mining. Such it is in the Princeton Mine, and the Hayward, Amador Co. Mine, the ore of these two mines often so closely resembling each other that by a hand specimen they cannot be distinguished.

Speaking of the Mother Lode, the Commissioner of Mines in his last report (1872) says: "The pros-

pects of the future are encouraging. At all points where great depth has been attained, there has been a steady improvement in the quality and quantity of the rock. At Sutter Creek the Amador Mine (Hayward's) has attained a depth of 1,300 feet, disclosing a vein of from 12 to 14 feet in width. The quality of the quartz here has improved with each successive level below a depth of 500 feet."

This statement has great significance when applied to the Princeton Mine, which has not yet been opened much below 500 feet in depth on the slope of the vein, and to explore which to a vertical depth of 1,200 feet, or 1,000 feet lower than the deepest of the old workings, a new downright shaft is now sinking by the present administration. Ultimately it will be possible to underdrain all the body of ores between the Merced River and the Princeton series by a deep tunnel brought up from Ophir Mills along the course of the Mother Lode, which it will open, at numerous points, not now accessible, or wholly unknown.

It is on the Mariposa Estate, then, that the Mother Vein makes some of its most remarkable developments.

Speaking of the old workings of the Josephine Mine, the U. S. Commissioner of Mines says (1st Report, p. 13): "The quantity of low grade ore still in the reserves is immense, and the amount of mining

ground not yet opened beyond calculation. The Josephine and Pine Tree are the two mines on which the immediate development of the Mariposa Estate and the recovery of the Company's fortunes depends."

"It is evident that on the great extent and excellent position of the Josephine and Pine Tree the first operations must be based."

The longitudinal extent of the "pay shoot" on the Pine Tree Mine, which has been laid open and measured, is over 900 feet. I do not remember any other mine in California in which the pay shoot is so long as this. It has varied in thickness from 30 feet to 6 feet, averaging over 10 feet. Its average value in mill, as given in the Report of the Mining Commissioner for 1864, is $16.40. From my own notes, I find in 1864 it was about $10 per ton. In the Josephine Mine the average width of the vein has been from 12 to 16 feet, and its average value to the ton in gold $26. The quantity of its ore is simply immense: and if we consider the great depth at which its reserves will be laid open by the River Tunnel, and the extent of the productive ground, it will be seen, by a simple calculation, how vast are the resources of the mines opened and to be opened on the "Mother" alone, upon the Mariposa Estate.

Take, for example, a known extent of 1,000 feet of quartz, 10 feet in average thickness, and 1,500

feet above drainage. Such a block of ground, if continuous, would contain over one million one hundred and fifty thousand tons of quartz (say 1,153,846 tons); call it, for easy calculation, 1,000,000 of tons, and suppose it to be worth $10 net per ton, the value is obvious.

But it is probable there is more than one such block of ground to be laid open by the River Tunnel, all deliverable at the Ophir Water Mills by gravity, at a minimum mining cost. To reduce such a quantity of ore as this, would require 33 years, at 100 tons daily, for 300 days of the year; or if 300 tons daily were reduced, it would still require 11 years, with a net product of $1,000,000 annually.

Calculations of this kind are of no importance, beyond showing to those not accustomed to regard such operations, how large the quantities under consideration are. It is obvious that in exploring progressively upon so extended a scale as is now commenced upon the Mariposa Estate, it will be in the power of the administration to elect from what ore bodies they will draw their supplies—using first the richest ores available, and from the treatment of smaller quantities, obtaining higher values.

Great as is the water power of the Merced River at Ophir Mills it has its limits—which, without the construction of another dam, cannot be increased—and this limit of power is in reality the limit of produc-

tive power in the Estate, unless the old system of steam mills is again restored. If this necessity should arise hereafter, it will be possible to obtain fuel at a cheaper rate now than formerly by the aid of the railway system.

3.—OF THE PRINCETON MINE.

The Princeton Mine has a history which places it among the most noted gold mines in America. There is, says Prof. W. P. Blake (who has made it a special study), reason to believe that the total product of this mine has been nearly $4,000,000. It appears from good authority that the actual production of the Princeton mine was as follows: From

June, 1860, to April, 1862	32,585 tons produced	$527,623
For 2 years ending Jan. 1, 1864, (Olmsted's Report, April, 1864,)	121,000 tons "	1,990,000
Produced in 1864		243,000
		$2,761,123
Assumed (unrecorded) product prior to June, 1860, (Blake)		1,000,000
Total		$3,761,123

It was abandoned in 1864, when the receiver took possession, just at the moment when it gave signs, after a temporary decline in value, of an increasing yield. It was then allowed to fill with water, and the old works, which were never well planned, and still worse executed (see my report of 1864), have all

become useless, and it would be the height of folly to attempt to reopen them in the old ground. We can afford to forget the past abuse of this remarable mine by our predecessors, seeing the one lesson it has taught us is preserved—namely, the position of the old bonanza, or rich chimney, and where to find it again. I am now speaking of the *old* Princeton Mine, and not of the important developments which have recently been made on what may be properly called the *Princeton Set* of mines. But as I have not personally examined these new discoveries—and it is not proposed now to proceed with their immediate development—I shall not refer to them again until I have had an opportunity to study them on the ground.

A careful study of the known peculiarities of the Princeton Lode has led Mr. Gourguet and Mr. Brumagim to fix on the position selected for sinking the new shaft. It is but just to Mr. Easton, for some time Manager of the mines on the estate, under the existing company, to say that he, also, arrived independently at the same conclusion, and Mr. Blake advocates a like policy. The pay shoot on the Princeton was of unusual extent horizontally—being about 800 feet. It pitched to the southeast at an angle of about 17° to 20°, while the vein pitches to the northeast at an angle of about 54°.

The new shaft has been located at a point where it is believed it will cut this rich ore body at the depth, vertically, of about 1,000 feet *below all the old workings*. At the depth of 560 feet, a level run, to intersect the vein at a distance of 480 feet from the shaft, will render the mine productive of ore, with stopes of 200 feet under the lowest of the old workings, and an extent laterally which there is good reason to expect will equal the old chimney above, of which it is, in fact, only the prolongation in depth. The shaft will go on sinking without interruption, and before it touches the vein three other levels, each shorter than its predecessor, will strike the vein, respectively, at 360, 240 and 120 feet, giving to each level 200 feet of stopes.

After the shaft reaches the vein at 1,200 feet depth, there is no reason why sinking should not be continued, either vertically or on the slope of the vein; but that is a question so remote in time that we may safely postpone its present consideration.

Without going now into details (all of which can be fully given hereafter), it suffices to say that Mr. Gourguet, who has made the computations, states that the ores laid open by this exploration will supply 50 tons of ore daily for at least seven years—computing the vein to measure an average of three feet—which is less than its former average.

In the Amador Mine, on the Mother Lode, the vein

grew larger below the depth of five hundred feet, and was, when I saw it, 12 to 14 feet thick, and averaging about $20 gold per ton in the Mill. From the entire similarity of the Princeton to the Amador quartz and slates, such an enlargement of the Princeton would not be remarkable, while its effect on the value of the property would be very much so.

The new shaft is laid out eight by sixteen feet, divided into three compartments—two for cages, and one for bucket and pumps. It will be timbered and equipped in the most approved style of this kind of work. In the sinking of this shaft, advantage will be taken of all the elements of rapid and economical working which are now known to the art of mining. Machine drilling, compressed air, Giant Powder, Chinese labor, will all be called into requisition. It has thus far been sunk by hand labor only, but as soon as the machinery is in place, it will be sunk with the aid of all the appliances to secure speed and economy.

Six Chinese and two white men are all the staff at present employed. The Chinese are paid $1.25 per day, and are in all respects good miners and faithful men. The boilers, engines, hoisting gear and pumps for sinking to 500 feet are on the ground, and nearly ready for use, and 20,000 feet of mining timber and lumber.

The best basis of calculation, available for the cost

of this important work, are the data, furnished by the experience of the Amador Company in 1870–71, in sinking their new north shaft to a depth of 1,165 feet in the body of vein. The Amador Shaft is in the clear 6 by 13 feet (the *width* being that of the vein, which was all taken out, is variable), divided into three compartments.

The red spruce square timber, for sills and legs, are 20x20, the centre pieces and caps, are 12x20 inches. The time occupied in sinking this shaft at Amador 985 feet (180 feet of the top had been formerly sunk), was eleven months (of which two months were lost by "a strike" among the men).

The entire cost of these 985 feet was $33,299, or $33.06 per foot. This cost covers labor, lumber, timber, carpenter work, fuse, explosives, lights, smiths' work, etc. It also included the cost of turning off three levels into the mine.

There were no costs of pumping, chargeable to this work, as the mine was already open and worked to the same depth by other shafts. The rate of sinking was about 3½ feet per day. If this rate can be attained at the new Princeton Shaft it can be sunk in a year. Mr. Gourgnet has, at my request, submitted to me his calculations, both of cost and time, and these justify the statement, that a year's time, and a cost of $50,000, will see the new shaft at the depth of 1,200 feet. Until I

have had an opportunity to examine the work on the ground, I make no statement of my own respecting it. The present exploration relates to the old Princeton Mine proper, and until it is made fruitful, nothing will be done, in the way of the development of the Crœsus, or of the line of mines, yet almost unknown, beyond the point of junction of the two branches of the Princeton—a mile southeast of the old mine. It is believed that a great future is in store for the Estate in these developments, at a not distant day.

A very important statement respecting the Princeton Mine is made by Mr. Gourguet, in charge of the works, in his letter of August 14th, in reply to certain queries by the writer. Mr. G. says: "Also, gathering my recollections of the old work done by me on the Princeton Mine, I remember well, that at the depth of 168 feet, eighty feet southeast from Turner's Shaft, the vein divides in two; the upper one, runs in the hanging wall, easterly, and the foot wall one, runs southeasterly. This foot wall one, is the one which the Company followed, and the other, they passed by unnoticed. So presuming to strike the vein which runs in the hanging wall 100 feet sooner than the Princeton one, induced me to cut it as deep as possible." This division of the vein into two separate and distinct branches, is perfectly in

accordance with what is found to be the case with the Mother Vein elsewhere, and has been already sufficiently explained. If Mr. Gourguet's statement is correct (which there is no reason to question) we find a satisfactory explanation, of the sudden falling off in value of the Princeton ores, in the latter part of Mr. Olmsted's administration. Of the two divisions of the vein the foot wall portion probably represents the barren or "boulder ledge," while the hanging wall division carried most of the gold.

4. REDUCTION OF THE MARIPOSA ORES.

The cost of reducing gold ores, in mills driven by water power, is not more than one third or one fourth part, the cost by the steam mills. In the old Benton Mills, the Pine Tree and Josephine ores were crushed and treated, for about 80c. per ton, and the cost of reduction by water at the Sierra Buttes Mills is about 90c. per ton. One of the engineers of Central Pacific Railroad, who has lately examined the problem, states, as I am informed by Mr. Brumagim, that the Princeton ores can be placed by a narrow gauge road at the Ophir Mills for 50 cents per ton.

The three Ophir Mills now standing at the Merced River have the following power: Bessie (lower mill), 24 stamps of 400 pounds; Ada (middle

mill), 60 stamps of 500 pounds, and Lily (upper mill), 16 stamps of 650 pounds. The "Bessie" is what is left in condition of an older 48 stamp mill. It is too low down, and liable to inundation in times of flood; we may, therefore, count it out at present, and say, that there are 76 stamps in efficient condition. The "Ada" is so arranged that it can be extended to any desired number of stamps; and the old mill, "Bessie," can be restored at a moderate expense to its original number of 48 stamps, which would make the available crushing power of the Ophir Mills 48+60+16 =124 stamps, which readily crush 150 tons of quartz daily, of which the Princeton should easily furnish 50 tons, and the Josephine and Pine Tree openings, 100 tons. As fast as the mines on the Estate are developed by the progressive plan, contemplated by the present management, it will be easy to extend the milling facilities to any desired extent, up to the full limits of the water power at command.

Ores of no value heretofore can now be worked at a profit.

Important improvements in the methods of amalgamation of ores have been made in the last ten years, since it was estimated by a well known engineer that two thirds of all the gold in the ores of the Pine Tree and Josephine Mines were

lost in the old Benton Mills. Care will be taken to see that what is truly valuable in these improved methods is adopted, as, indeed, to a good degree, they have been already.

Estimates have been made, for the construction, at some future day, of a stone dam, just below the site of the existing one, which is of timber and earth. All the stone and materials for this construction are on hand. Such a dam would very greatly add to the reducing power of the Ophir Mills.

VII.—CONCLUSION.

This review of the nature and resources of the Mariposa Estate, and of the plan of development adopted, and now in progress, must be accepted as only preliminary, and advisory in its character, and by no means as a full and comprehensive report upon the whole Estate. Enough has been said to show, in general, what the property is, in some of the main features of its Northern or Merced Division. But, as may be seen by the attentive reader, there are very important portions, even of this division, to which only the most cursory allusion is made. Such, for example, is the southeast extension of the Princeton set, and the Mount Ophir system of veins.

Beyond, and outside of the Northern Division, to which we have now confined ourselves, are the Western Division, and the Mariposa Division, the latter including not only the Mariposa set of veins, properly so called, but in its southern extension, the whole of the Guadaloupe Valley.

Over the whole of these great areas, are many mines, already more or less completely tested, and on one of which, a fifty stamp mill already exists; not to speak of very numerous quartz veins, of greater or less promise, of which almost nothing is now known, beyond the fact of their existence, and of their carrying gold.

The development of these important portions of the Estate, is now under consideration, and will form the subject of another communication, when the working plans have been put into operation.

All of which are respectfully submitted.

Your obedient servant,

B. SILLIMAN.

September 3d, 1873.

VIII.—POSTSCRIPT.

Since this Review was prepared and submitted, additional information has been received from the Manager of this Estate of sufficient importance to

demand notice. Acting under my suggestions, by letter, some surface explorations have been made, over the line of the River Tunnel, with a view to fix, as nearly as possible, the points where the tunnel will probably open up gold bearing quartz, available for use in the mills, so soon as the tunnel shall be driven up to them.

A communication and sketch map, now on file in the New York office, from Mr. D. Gourguet, dated August 26th, recites: That he has been exploring the croppings of the quartz veins on the line of the River Tunnel, between the Pine Tree Mines and the mouth of the tunnel. In the diagram sent on by him, only the principal veins are indicated. The hill was covered with quartz derived from the veins, to follow all of which would require more time than he had to devote to the work.

By reference to the "Map of the Hill and Mining works between Ophir Mills and Linda Mine, with the position of the River Tunnel, surveyed and drawn by R. B. Thomas, June, 1873," and now on file in the Company's office, I am able to identify the markings on Mr. Gourguet's sketch, and find them to be as follows, viz:

1. About 400 to 500 feet from the mouth of the tunnel are numerous small stringers of quartz (marked A B by Mr. G.) running about the same direction

with the tunnel, and extending for 350 to 400 feet along its course. The hill, by Mr. Thomas' survey, rises from 200 to over 300 feet above the level of the tunnel, on the range of these outcrops.

Mr. G. expresses the opinion, that these several small veins will unite to form one vein, at a certain depth; and he assumes that when struck in the tunnel, this vein will be not less than seven feet wide or upwards: "The character of the quartz indicates a good mineralized vein." The dense "chapparal" (thick, thorny bushes) prevents tracing the full southerly extent of these croppings without much labor in clearing.

Another month or two, will probably see the end of the tunnel opposite these croppings, when they can be opened by a crosscut and explored. I venture no opinion on them. Mr. G. is a good judge of quartz, and his opinion, as a practical miner, and for many years resident upon the Estate, in charge of mining operations, especially upon the Princeton Mine, entitles his judgment to be received with attention and respect.

2. Further up the hill, are the heavy croppings of a well defined vein, marked by Mr. G. "C D." These are shown on Mr. Thomas' map to be about 1,250 feet from the mouth of the tunnel, and over 400 feet above its level. These croppings, which show a vein about $2\frac{1}{2}$ feet thick at surface, Mr. G.

has traced for about 150 feet up the hill, where they dip under, and reappear again, at a point 400 to 500 feet further up, continuing for a distance of 200 feet in length. This outcrop is marked by Mr. G. "E F."

They are shown on Mr. Thomas' map as occurring about 2,000 feet in, from the mouth of the tunnel, and are about 600 feet above its level. From these croppings, gold is obtained by prospecting with the horn spoon. The quartz is of a good appearance, and free from earthy and slaty matters, having "a dark, ochraceous, white and rusty appearance, the whole indicating a good vein."

3. Between these last two named sets of croppings are the old openings made, in 1852, upon what is known as the "Lower Specimen Vein," marked "G H" on Mr. G.'s sketch, which old works "are shown by Mr. Thomas' map to be 150 feet below the crest of the hill on the left; and 100 feet below them, farther down the hill, is a vein opened by a prospect hole, said to be 4½ feet thick. All the quartz thrown out by these last explorations has been carefully removed by the old miners, which circumstance, so far, goes to confirm the tradition of its exceptional richness. These old works will be explored by the tunnel when it is driven to a point about 1,500 feet from its mouth.

4. At a point, about 2,600 feet in, from the mouth of the tunnel, and extending for at least 600 feet

on its course, is a complex series of heavy croppings, on which some explorations were made before Fremont's time by the early miners. The hill here rises some 800 feet above the level of the tunnel, as seen upon Mr. Thomas' map. These openings are marked by Mr. Gourguet "J K," "L M," "N O" and "R S." They mark the position of the main "Specimen Vein," so called because of the remarkable richness of the quartz in gold. Mr. G. makes the portion "L M" 10 to 12 feet in thickness for 300 to 400 feet in length; below which, it is the vein "N O," 5 feet wide, running not quite parallel with the larger one for 300 feet, where it forms an elbow and joins "L M" at the point marked "P" by Mr. G. At this point the vein is four feet wide and prospects well. According to Mr. G.'s prospects he judges it should pay, in mill, not less than $30 per ton. Below this vein is another, marked "R S," 2½ feet wide, running the same course, pointing toward the junction of the two above described. Its two walls are remarkably smooth and well defined. The upper part of the vein has the same character as the ore of the Pine Tree Mine, and the lower part is "ribbon rock," resembling the ores of the Josephine Mine.

Mr. G. adds, in his own language: "Summing up the course and inclination of these veins, I am quite satisfied that below, lies a good sized vein,

in the main channel of the ledges, crossing the Mariposa Estate (*i. e.*, the Mother Lode). There, 800 feet below the surface, the River Tunnel will pass through their respective sections, and I firmly believe the Company will there find some rich deposits.

"The River Tunnel will offer an immense advantage in finding some new developments, and in reducing the cost of extraction, and in taking the quartz to the Ophir Mills."

I have already, in preceding pages, given my own reasons for the same opinions, which are now so far confirmed, by these more specific details. I have no doubt, that these several croppings, belong to the great system of the Mother Lode, and that, at the depths reached by the River Tunnel, we shall see on them remarkable developments, long before this important work reaches the ground beneath the famous Pine Tree and Josephine openings. It will be seen, by reference to Mr. Thomas' map and sections, that the highest outcrops of the Specimen Vein, are shown to be at a point 4,000 feet in, from the mouth of the Tunnel, and not less than 1,200 feet vertical over its grade, while the main explorations already made upon the Linda or Pine Tree are 6,350 feet in, from the mouth of the Tunnel.

From these statements, it is plain that the pros-

pects for reaching valuable stores of good ore, in virgin ground, are good at numerous points on the line of the River Tunnel, after we strike the first named series of croppings about 400 feet in from its mouth. It is proper to add that the explorations ordered on the surface over the line of the Tunnel are still continued, as opportunity offers.

The cost of driving this Tunnel, thus far, as appears from the accounts current, now on file in the New York office, including labor, materials, etc., with the track, or tramway, and drain complete, etc., has been $15.49 per lineal foot. Adding the salaries and some outside expenses, which do not properly belong to the cost of this work, the cost, per foot, rises to $18.84. It is safe, probably, to say that $20 per foot will cover all costs and contingencies.

This statement does not contemplate the anticipated diminution of cost when the improved car for working two Burleigh Drills side by side comes into use. The character of the ground thus far penetrated, is believed to be a fair average of what may be expected, although Mr. Darling, the Manager, finds reasons for expressing, in his last communications, the opinion that the ground already cut is harder than that which he has yet to encounter.

B. S.

September 25th, 1873.

Since the foregoing was in print we have received the following two letters from the Manager and Resident Physician, which are submitted to the stockholders :

BEAR VALLEY, *Sept. 18th*, 1873.

MARK BRUMAGIM, Esq.,

Prest. M. L. and M. Co.

DEAR SIR : In my letter of August 21st I therein mentioned that I obtained $30 prospect from one of the outcrops, etc. From *this* place I have taken out 16½ *tons* and crushed it, and to-day cleaned up 26 oz. retorted bullion, which, valued at $16 per oz. (think it will go more), yields per ton upwards $25. This is the first ore that ever has been worked from this place. Will write more fully to-morrow, giving full details, etc. Every one here is exceedingly joyful over the good result. In fact it is a good thing—a BIG thing. *No guess or hope* work about it. It is the *real genuine* truth and facts demonstrated, and, in my opinion, it is one of the *best* veins in California. Millions of dollars are here, only waiting to be taken out, milled and coined into $20 pieces. The location could not be better to work from the surface, or to be taken out through the River Tunnel, if the

tunnel was in to this place. We would soon repay your treasure tenfold what has been drawn from it.

The River Tunnel progressing better this week. Thus far our average drilling has been 78 feet in 24 hours—the machine running on an average 16 out of the 24. The balance of the time is occupied in removing the debris, laying track, etc. Prof. Silliman's letters to me and Mr. Gourguet received, and will be answered in due time. The one of the 9th at hand. I have examined all the maps and papers in the office and can only find the following:

"*c.* Longitudinal Section of the Princeton Mine, etc."

"*d.* Section of the Phillips Shaft, etc.,"

which I send by mail to-day.

Yours truly,

E. O. DARLING,

Manager.

OFFICE OF THE MARIPOSA LAND AND MINING CO.,
BEAR VALLEY, *September* 18*th*, 1873.

MARK BRUMAGIM, Esq.

DEAR SIR: It is with great pleasure and pride that I am able to communicate to you the intelligence that from the crushing of about sixteen tons of rock, taken out from one of the veins I wrote to you about, we obtained an average of twenty-six dollars a ton. At the expenditure of two thousand dollars this mine could be opened and a road constructed by which the mills could be furnished with fifty tons of rock a day, which should pay a net profit from this mine alone of from eight hundred to a thousand dollars a day.

As I told you in the paper I sent you, the whole mountain seems one mass of gold-bearing quartz, and from the result of the crushing of this rock I am confirmed in the confidence I expressed that you have here, near the mills, an inexhaustible supply of pay rock. This vein can be got at with ease, and the cost of mining, transporting and milling will not be more than six dollars a ton, leaving a net profit of twenty dollars a ton; and then it is very probable the rock will increase in richness as the vein is sunk on. The

few tons that were crushed were taken out within ten feet of the surface. From the position for working, proximity to mill, and all things considered, I think this the best vein ever struck upon the Estate, not excepting even Princeton.

Believing that the Rubicon is passed, and the future of this Estate is assured, I am as exultant as though I was the happy possessor of a large interest in the Mariposa Land and Mining Company. Truly yours, etc.,

J. B. W. BIDLACK, M. D.

Bear Valley, *Sept. 19th*, 1873.

Mark Brumagim, Esq.,
Prest. M. L. and M. Co.

Dear Sir: The place where I took out 16½ tons of ore, referred to in my letter of yesterday, is distant from the Pine Tree Mine, N. W. on the line of the tunnel, 3,450 feet, and at an elevation above the tunnel 750 feet—distance from the mouth of the tunnel 2,900 feet. The vein and veins around it lay something like this:

[*Diagram on file at the office.*]

"D" is the place where I took out the ore. on the *red* line, near the junction of the *blue line* and red. I have examined the condition of the old Smith Road (which lays on the east side, running down through a ravine to Ophir Mills) with Hammett, whose judgment on making and repairing wagon roads is considered good, as he has had a large experience in that business, and his estimate of cost for repairing this road, suitable for transporting 12 tons of ore at a load (with two wagons, "back action," attached to the front one), is one thousand dollars. And he will also agree to deliver the ore, from 40 to 50 tons per day, for one dollar per ton; and if after a

trial he finds he can deliver it cheaper, he will do so—thinks perhaps he can deliver it for seventy-five cents, but *will agree to deliver it any way for one dollar*, and cheaper if he can. It will also cost about one thousand dollars to open the mine so that we can work to an advantage. Mr. Hunt's estimate for *labor* for mining the ore is from $1.50 to $2.00 per ton. And as we will not require much timber for a long time the supplies will not be large—say about one dollar per ton, he thinks.

Now, we will double the cost of mining, in order to make *ourselves doubly sure*, and we have the total cost of mining and transportation as follows :

Labor for mining, per ton	$4 00
Supplies " "	2 00
Transportation	1 00
	$7 00
Milling, per ton	1 50
Total Cost—Mining, milling and transportation	$8 50

These figures are high—the cost will not reach it. By repairing the old Smith Road, we will prepare a way to deliver the supplies needed at the River Tunnel by team, instead, as we have to do now, take the supplies to Pine Tree, and then load them into cars and run them down over the railroad—we will save the expense of

keeping the railroad in repair, and, besides, a great deal of bother. We will always have to have a way to deliver our supplies to the river, either by a wagon road or the railroad. In my opinion it would be much cheaper and better to deliver them by wagon. Our store team, then, could deliver all except lumber and timbers, and they could be delivered with proper teams much cheaper by wagon than by cars; so you see, by repairing the Smith Road, we accomplish two things of importance: 1st. To transport our ore; 2d. To deliver our supplies to the tunnel, which, after we get to taking out ore through it, will require a large amount.

I have herein given you some data to assist you in deciding whether it will be advisable to commence work on the surface in this place or not. In the meantime I will put two men at "D" and sink down say 20 or 25 feet, which will give me a better idea how to proceed. Should you order the work to go on, I am confident that there is a large amount of money in this vicinity.

Trusting you will give this matter a careful consideration. I remain yours truly,

E. O. DARLING,

Manager.